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Series Title **AGRICULTURAL MEMORANDUM** **No 1097**

Title Agricultural Land Classification Scheme 1988 - Climatic Aspects

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Abstract

The Agricultural Land Classification Scheme provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use.

The principal physical factors influencing agricultural production are climate, site and soil. These factors together with interactions between them form the basis for classifying land into grades.

The main broadscale climatic factors are temperature, rainfall and parameters biased towards temperature and rainfall although local account is taken of exposure, aspect and frost risk. Soil characteristics of particular importance are texture, structure, depth and stoniness. Climatic, and soil factors result in varying degrees of constraint on agricultural production. They can act either separately or in combination. The grade or subgrade of land is normally determined by the most limiting factor present.

Grid point agrometeorological datasets have been created towards objective assessment of land grade.

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Keywords Accumulated Temperature, Aspect, Droughtiness, Erosion, Evaporation, Field Capacity Days, Grass, Land Classification, Potatoes, Rainfall, Soil Moisture Deficit, Wetness, Wheat, Wind.

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1. INTRODUCTION

The Agricultural Land Classification Scheme (ALC) (MAFF 1988) provides a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use.

The principal physical factors influencing agricultural production are climate, site and soil. These factors together with interactions between them form the basis for classifying land into one of five grades (grade 3 has two sub-grades).

The main broadscale climatic factors are temperature and rainfall although local account is taken of exposure, aspect and frost risk. The site factors used in the classification system are gradient, micro-relief and flood risk. Soil characteristics of particular importance are texture, structure, depth and stoniness. These climatic, site and soil factors result in varying degrees of constraint on agricultural production. They can act either separately or in combination, the most important interactive limitations being soil wetness and droughtiness.

The grade or subgrade of land is normally determined by the most limiting factor present. When classifying land the overall climate and site limitations should be considered first as these can have an overriding influence on the grade.

To provide an objective assessment scheme, where possible, the data have been produced as a grid point dataset with a 5 km resolution. The content of this paper is closely related to the official reference document (MAFF 1988), a published version of the datasets is available (Met. Office 1988).

2. THE GRADES AND SUBGRADES

The ALC grades and subgrades are described in terms of the types of limitation which occur, typical cropping range and level and consistency of yield. The most productive and flexible land falls into Grades 1, 2 and Subgrade 3a and collectively comprises about one-third of the agricultural land in England and Wales. About half the

land is of moderate or poor quality in Subgrade 3b or Grade 4. (MAFF 1988) explains these grades in greater detail.

3. GUIDELINES FOR ASSESSING LIMITATIONS

The remainder of this paper explains why and how the meteorologically based limiting factors where chosen for use in the ALC system.

3.1 CLIMATIC LIMITATIONS

Climate has a major, and in places overriding, influence on land quality by affecting both the range of potential agricultural uses and the cost and level of production. Its most fundamental influence is on the potential for plant growth, by determining the energy available for photosynthesis and water supply to plant roots. The effect on plant growth occurs partly through interactions with soil which determine soil wetness and droughtiness. There are also more direct effects on crops or stock such as exposure to damaging wind, persistent wetness or high humidity and frost which can cause physical damage, disease or stress. It is therefore necessary to include in the ALC an assessment of the overall climatic (or mesoclimatic) limitation in addition to the interactive limitations.

The general principle followed is to assign increasing degrees of limitation to agricultural use as rainfall increases and average temperature decreases. Thus, in climatic terms, the poorest areas are both the wettest and coldest and conversely the climate is regarded as more favourable as temperature increases and rainfall moderates.

Keers (1983) reviewed the range of possible parameters for ALC assessment of climate. The two parameters finally agreed and currently used in the assessment of the climatic limitation are average annual rainfall (AAR), as a measure of overall wetness, and accumulated temperature (ATO), which is a measure of the relative warmth of a locality. Accumulated temperature is the integrated excess of daily air temperatures above a selected threshold temperature, summed over a specified period (Met. Office 1969). When calculated over an appropriate part of the growing season it can be used as an indication of heat energy input and soil drying potential, it has also been shown to correlate with crop growth and yield. Work

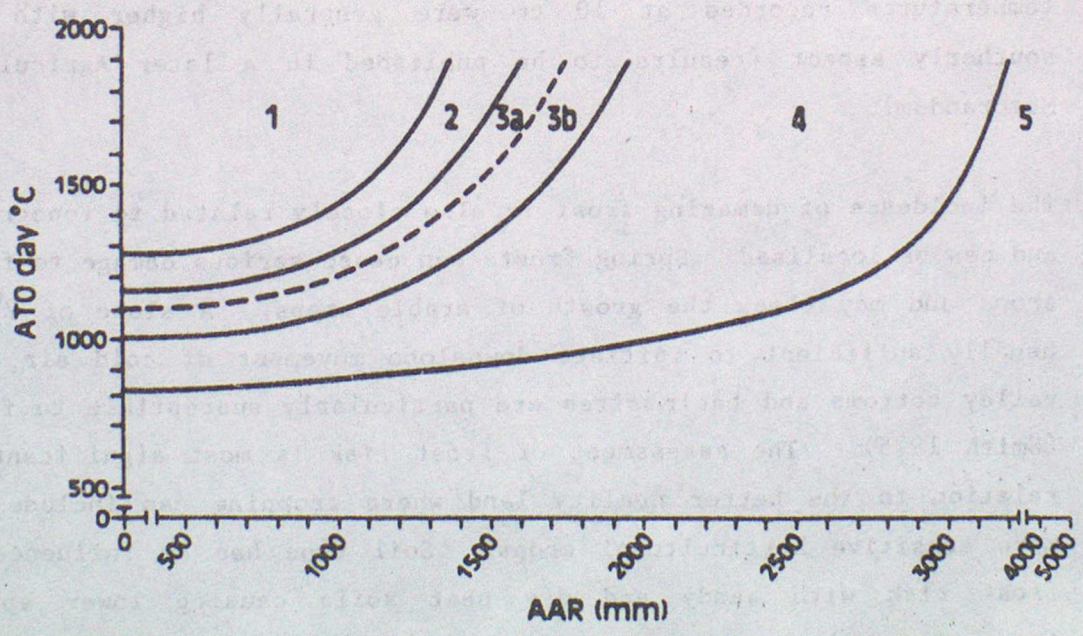
on grass (Peacock, 1975) and cereals (Biscoe and Gallagher, 1978) showed that leaf extension occurs, albeit slowly, down to temperatures as low as 0°C, which is adopted as the threshold temperature for the ALC system. Accumulated temperature is calculated above 0°C for the period January to June (ATO), the critical growth period for most crops, even if they are autumn sown.

The above parameters provide the basis for the evaluation of the mesoclimate. Microclimatic factors including aspect, exposure and frost risk are also considered when grading land but are not easily quantified and require careful judgement for individual sites (see 3.1.2).

3.1.1 Assessment of the overall climate limitation

The combinations of rainfall and accumulated temperature for each ALC grade and subgrade are defined graphically in Figure 1. The AAR and ATO datasets used for this assessment are described in Appendix 1.

Figure 1. Grade according to climate



3.1.2 Local climatic factors

At the local scale differences in the aspect, gradient and elevation of the land can significantly modify the overall climate, particularly in relation to temperature, frost risk and exposure.

Aspect can have a marked influence on the amount of solar radiation that a site receives. In general, and unless there are exposure differences, mean daily temperatures and hence accumulated temperatures are higher on south facing slopes than on slopes facing in other directions. Radiation intensity varies with slope angle such that differences due to aspect are more marked on steeper slopes (up to a limit) (Brandtner 1975). The relationships are often more complex in valleys due to the effect of shading, which can moderate the benefits of a southerly aspect and increase the penalties on north facing slopes. Lee (1984) discussed a theoretical approach to the effect of aspect upon accumulated temperatures near the ground. Work continues to adapt Lee's work for screen level temperatures; provisional ideas suggest reducing the ground level changes by at least 25%. From some ongoing work in Wales, the beneficial effects of a southerly aspect are unlikely to be reflected in air temperature if too openly exposed. For the period April to September 1988 on an 18^{o} slope the southerly aspect exposed to winds from between WNW though S to ENE had predominantly lower temperatures in the air than the north side of the hill top only exposed to from WSW through N to NE. Soil temperatures recorded at 10 cm were generally higher with the southerly aspect (results to be published in a later Agricultual Memorandum).

The incidence of damaging frost is also closely related to topography and can be localised. Spring frosts can cause serious damage to fruit crops and may check the growth of arable crops. A slope of 2^{o} is usually sufficient to initiate downslope movement of cold air, and valley bottoms and basin sites are particularly susceptible to frost (Smith 1975). The assessment of frost risk is most significant in relation to the better quality land where cropping can include the more sensitive horticultural crops. Soil type has an influence on frost risk with sandy and dry peat soils causing lower spring temperatures than wetter clay soils (Hough 1983).

In certain situations exposure may constitute a significant climatic factor. Persistent strong winds can harm crops and livestock, especially in wet weather (Grace 1977). Upland areas, and land which stands above the surrounding countryside, are often exposed to stronger winds. Many coastal districts are exposed to strong, salt-laden winds and their effects can extend for several miles inland. Windspeed is strongly influenced by topography. In general, wind velocities increase with altitude and decrease with distance from the west coast, while the funnelling of winds along valleys, particularly in the uplands, may result in consistently higher windspeeds.

3.2 INTERACTIVE LIMITATIONS

The physical limitations which result from interactions between climate, site and soil are soil wetness, droughtiness and erosion. Soil wetness expresses the extent to which excess water imposes restrictions on crop growth and cultivations while droughtiness indicates the degree to which a shortage of soil water influences the range of crops which may be grown and level of yield which may be achieved. The limitations are not mutually exclusive in that some soils can be wet in winter but droughty in summer. For ALC purpose wetness and droughtiness are assessed separately by relating soil profile characteristics to appropriate climate parameters.

3.2.1. Soil Wetness

A soil wetness limitation exists where the soil water regime adversely affects plant growth or imposes restrictions on cultivations or grazing by livestock. Excessive soil wetness adversely affects seed germination and survival, it also inhibits the development of a good root system and can, in extreme cases, lead to plant death (Hegarty 1976). Soil wetness also influences the sensitivity of the soil to structural damage and is therefore a major factor in determining the number of days when the soil is in a suitable condition for cultivation, trafficking by machinery or grazing by livestock.

The severity of the limitation is influenced by the amount and frequency of rain in relation to evapotranspiration, the permeability of the profile and the texture of the topsoil (MAFF 1988). Soils with a high clay content tend to retain more water than sandy soils and are therefore slower to return to a workable condition after wetting.

For ALC purposes the soil wetness assessment takes account of:-

i) the climatic regime;
ii) the soil water regime;
iii) topsoil texture

Climatic regime. The influence of climate on soil wetness is assessed by reference to median field capacity days (FCD). For more detail of FCD datasets see Appendix 1.

Soil water regime. This assessment is based on a soil wetness class model (MAFF 1988).

Topsoil texture. Mineral soil texture classes are divided into four groups according to the ease with which they can be cultivated. (MAFF 1988).

The interaction between these parameters and the allocation of ALC Wetness Grade is covered in detail in (MAFF 1988).

3.2.2 Droughtiness assessment

To achieve full yield potential a crop requires an adequate supply of soil moisture throughout the growing season. Soil moisture requirements vary considerably between crops and according to growth stage.

Droughtiness is most likely to be a significant limitation to crop growth in areas with relatively low rainfall or high evapotranspiration, or where the soil holds only small reserves of moisture available to plant roots. The severity of the limitation in an area depends on the relationship between soil properties and climatic factors and the moisture requirements of the crops grown. These relationships are complex and the degree of moisture stress varies from year to year according to the weather.

Initially Keers (1984, 1985) suggested a droughtiness model designed not to be specific to a particular season and not crop specific but

inability to calibrate the model to work across all parts of England and Wales lead to the method being abandoned in favour of a simplified method for assessing droughtiness based on work by Thomasson (1979). It provides an indication of the average drought risk based on two reference crops, winter wheat and maincrop potatoes. These crops have been selected because they are widely grown and are representative of a broad range of crops, in terms of their susceptibility to drought. The method used to assess droughtiness takes account of crop rooting and foliar characteristics to obtain an estimate of the average soil moisture balance (MB) for the reference crops at a given location. MB is calculated as the difference between:-

(i) crop-adjusted available water capacity of the soil profile (AP)
(ii) moisture deficit (MD).

Crop-adjusted available water capacity (AP). AP is a measure of the quantity of water held in the soil profile which can be taken up by a specified crop (MAFF 1988).

Moisture deficit (MD). The moisture deficit term used in the ALC droughtiness assessment is a crop-related meteorological variable which represents the balance between rainfall and potential evapotranspiration calculated over a critical portion of the growing season. The concept of potential evapotranspiration (PE) was introduced by Penman (1948) who defined it as the water transpired by a short green crop, such as grass, which completely covers the ground surface and has an ample supply of water. PE is used in combination with rainfall (R) to calculate potential soil moisture deficit (PSMD) (Smith, 1967) as follows:

$$PSMD = (R-PE)$$

where (R-PE) is calculated daily and summed for a defined period.

In most areas under normal agricultural use, a deficit will typically develop in April or May and will reach a maximum in July, August or September; thereafter it will decrease as evaporative losses fall in the autumn. PSMD can be calculated for monthly periods and the

maximum monthly value in any year is used to indicate the shortfall in moisture supply for that year. For land classification purposes the PSMD is calculated over a period of years and the median value of PSMD is used to avoid the bias of extreme years. Deficits under grass are greater than for arable crops which do not attain full ground cover early in the growing season.

Winter wheat does not usually develop full leaf cover until the end of April. Maincrop potatoes have negligible leaf cover until mid-May and full cover is not usually achieved until the end of June. Jones and Thomasson (1985) describe a method for deriving MD values for wheat and potatoes from median end-of-month and mid-month accumulated values of PSMD (under grass) as follows:

MD (Winter wheat) = mid-July PSMD - 1/3 April PSMD

MD (Potatoes) = August PSMD - 1/3 June PSMD - 1/3 mid-May PSMD

Crop-adjusted values of MD based on these formulae are used for droughtiness assessment in the ALC system. Attempts to obtain the necessary spatial distribution of PSMD, and thereby MD data with sufficient accuracy, based on the limited station data available for the calculation of PE values proved impossible (Field 1983b, 1983c). PSMD values for ALC purposes are obtained by means of regression techniques from summer accumulated temperature above 0°C (ATS) and summer rainfall data (ASR). See Appendix 1 for details of ATS and ASR datasets and Appendix 2 for details of the derivation of PSMD/MD values.

Droughtiness limits for grades and subgrades are defined in terms of moisture balances (MB) for wheat and potatoes which are calculated using the following formulae:-

MB (Wheat) = AP (Wheat) - MD (Wheat)

MB (Potatoes) = AP (Potatoes) - MD (Potatoes)

MB limits for ALC grades are detailed in (MAFF 1988).

3.2.3 Soil erosion

Soils are eroded and transported by the actions of wind and water. Erosion by rainfall and associated run-off is the more widespread phenomenon and can occur throughout England and Wales in a variety of physical and climatic conditions; Morgan (1985) has attempted to map risk areas.

For erosion to occur, the interaction between erosive forces and soil characteristics needs to be complemented by a combination of other environmental parameters such as slope, catchment area, vegetation cover, crop and soil management. It is therefore not possible to predict erosion risk without very detailed studies of all the climatic, physical and management conditions in a given area. Morgan's maps do not consider management conditions.

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May 1988 revised October 1988

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APPENDIX 1

AGROCLIMATIC DATASETS

INTRODUCTION

Climatic data are used in the assessment of climate, droughtiness and wetness limitations. To provide consistency in those assessments a standard data source is required for the calibration and operation of the system. Traditionally, maps or meteorological station data have been used to estimate climatic parameters at a site. However, the manual interpretation of maps or extrapolation of values from recording stations to sites under investigation involve subjective judgement, and even where data are available from a nearby meteorological station it cannot be assumed that the station value is representative of the surrounding area. A number of gridpoint datasets with a spacing of 5 km have therefore been developed covering the whole of England and Wales and standard methods have been devised for estimating the value of each parameter at any location. The grid is coincident with the 5 km intervals of the Ordnance Survey National Grid, having its false origin near the Isle of Scilly.

The use of gridpoint data has significant advantages for computerised storage and manipulation of information. The datasets are held in LandIS, a computer-based land information system which has been developed jointly by Ministry of Agriculture Fisheries and Food (MAFF) and Soil Survey and Land Research Centre (formerly Soil Survey of England and Wales) (SSLRC). The system can be used to obtain both gridpoint and interpolated values for specified grid references (Met. Office 1988).

1. CLIMATE DATASETS

The five agroclimatic parameters used in the ALC system and the associated limitation factors are listed in Table 1. The FCD dataset was compiled by the SSLRC based on Meteorological Office data. The other datasets were compiled by the Meteorological Office and processed by the SSLRC prior to their incorporation in LandIS. A 5 km dataset of average annual rainfall change with height is also held on LandIS for use in the interpolation from grid point values to site estimates, together with topographic height values representative of the immediate vicinity for each 5 km grid point.

Table 1 Limitation factors and associated agroclimatic parameters

Limitation Factor	Parameter	Observation Period
Climate	Average Annual Rainfall (AAR)	1941-1970
	Median Accumulated Temperature above 0°C, January to June (AT0)	1961-1980
Soil Wetness	Median Duration of Field Capacity Days (FCD)	1941-1970
Soil Droughtiness (Paramaters used to calculate a Moisture Deficit (MD) value)	Average Summer Rainfall, April to September (ASR)	1941-1970
	Median Accumulated Temperature above 0°C, April to September (ATS)	1961-1980

The data sources are explained in section 2.

For a listing of these data plus the derived variable MD and the method for interpolating from surrounding grid point values to obtain a site estimate see (Met. Office 1988). Two other datasets used in the interpolation techiques that are included in the publication are lapse rate of AAR and height above mean sea level.

In brief, the stages to get from grid point data to an interpolated site value of the meteorological variables are:

a. Select grid points surrounding site
b. Adjust grid point values to height of site
c. Mean grid point values biased by distance from site

In some instances data may be available for a meteorological station near to a site and the interpolation from gridpoint values may differ from the nearby station value. It should not necessarily be assumed the nearest station value is the most appropriate - station data can be less suitable because of one or more of the following reasons:

a. Data period different from gridpoint data.
b. Met. Station data is often influenced by unique local features.
c. Changes in local Met. Station features or observing practices during the observing period.
d. Significant difference in topographic features between Met. Station and site.

As an aid to ALC assessment, station data will be more suitable if:

a. The site and station are in close proximity.
b. The site and station have very similar topographic features.
c. There is more than one station near to the site giving similar values.

2. ORIGIN OF METEOROLOGICAL DATASETS

2.1 Average Annual Rainfall - AAR (1941 to 1970)

The period 1941 to 1970 is an internationally agreed standard climatological period. The next period is likely to be 1961 to 1990.

Station data from several thousand rain gauges were plotted on 1:250,000 scale topographic map and the data were analysed paying particular attention to topographic effects on spatial distribution of rainfall. Isohyets were later transferred to a 1 : 625,000 scale for publication (Met Office 1977). The gridpoint AAR values were interpolated from the isohyets on the 1:250,000 scale.

2.2 Average Summer Rainfall - ASR (1941 to 1970)

Similar to AAR but base map was drawn at 1:625,000 scale and is unpublished.

2.3 Lapse Rate of AAR - (1941 to 1970)

This dataset was based on a regression using the grid point values from 2.1 for the particular gridpoint and the surrounding eight grid points. From the AAR and height (section 2.4) of these 9 gridpoints a simple linear regression produced a lapse rate for the 10 km square area centred on the particular gridpoint. This was taken as the best estimate for the lapse rate at the particular grid point.

2.4 Topographic Height

For each gridpoint, a height representative of the near vicinity of the gridpoint has been produced based on fine scale 0.5 km resolution dataset held by the Met. Office. The height is not a spot value, but adequately represents the height at the grid point.

2.5 Median Accumulated Temperature Above 0°C - ATO and ATS (1961 to 1980)

For developing a suitable climatology, temperature data over a sufficiently long period (20 years or more) are not available for a large number of stations over England and Wales, particularly daily data. The Meteorological Office have created the Complete Agromet Dataset (Field, 1983a, Harvey 1983) with 94 stations having complete records over the period 1961 to 1980. These data have been used as the basis for the ATO and ATS datasets.

Median rather than mean values have been used to remove the bias that would be introduced by one or two extreme years. With the well established relationships between accumulated temperature, height above sea level and distance from the south and west coast, the regression equations below were found to be the most accurate method of producing a 5 km gridpoint dataset:

$$ATO = 1708 - (1.14 * H) - (0.023 * E) - (0.044 * N)$$

$$ATS = 611 + (1.11 * ATO) + (0.042 * E)$$

where

H is height above mean sea level

E is National Grid easting (four figures)

N is National Grid northing (four figures)

These regressions explained around 90% of the variability of ATO and ATS for the 94 stations.

Initially ATO grid values were interpolated from isotherms analysed at 1:625,000 scale but the data were less accurate than the regressed values.

2.6 Field Capacity Days - FCD (1941 to 1970)

This is the length of time from when the soil returns to full moisture (or field) capacity after the Summer until the water content falls below full capacity, usually sometime in the Spring. Some allowance is made for temporary interludes, often at the beginning and end of the period, when the soil moisture status alternates between full and less than full capacity over short periods. To prevent the data being biased towards one or two wet or dry years in the period, the median value is used.

The gridpoint data used were developed by the SSLRC based on Meteorological Office data (Jones and Thomasson 1985). In the future FCD derived from the single station version of the MORECS program (Thompson et al 1981) may be substituted into the system.

2.7 Moisture Deficit (MD) Data

The gridpoint values of crop-adjusted moisture deficit required for droughtiness assessments are obtained by regression from ATS and ASR (See Appendix 2) using the following equations:

$$MD\ (\text{Winter Wheat}) = 325.4 - (162.3 * \log_{10} ASR) + (0.08022 * ATS)$$

$$MD\ (\text{Potatoes}) = 326.4 - (196.5 * \log_{10} ASR) + (0.1127 * ATS)$$

The above equations are based on an analysis of station data in the Complete Agromet Database (Field, 1983a) and explain approximately 90% of the variation in crop-adjusted MD at those stations. When these equations result in negative values they are assumed to be zero for the purpose of droughtiness calculations.

APPENDIX 2

DERIVATION OF MOISTURE DEFICIT TOWARDS DROUGHTINESS ASSESSMENT

1. INTRODUCTION

The meteorological contribution to the droughtiness assessment is the moisture deficit (MD); an interaction between rainfall and evapotranspiration. The rate of water loss to the atmosphere (potential evapotranspiration PE) varies with meteorological conditions - temperature, humidity, radiation and windspeed - the development of the plant and the ground it covers. The rate of transpiration diminishes as the soil dries and water reserves become exhausted.

Calculation of evapotranspiration is based on the single station version of the MORECS program (Thompson et al 1981) for all 94 stations (later reduced to 83 see page 30) in the Complete Agromet Dataset (CAD) (Field 1983a), although some stations may not record the required meteorological parameters more than once a day.

The potential soil moisture deficit (PSMD) can be calculated as follows:-

$$PSMD = \sum (R-PE) \text{ mm}$$

2. MAPPING PSMD

Field (1983b, 1983c) summarised the problems with producing PSMD on a 5 km grid. PE varies less than rainfall, annual averages ranging from about 600 mm in SE England to less than 300 mm in the uplands of the north and west. The distribution of PE values is uneven throughout the year with a peak in June or July, and only 10 to 15 per cent of the total is transpired between October and March.

Year to year variation is small with standard deviations of only 25 to 30 mm in most districts, whereas deviations of annual rainfall are greater than 100 mm. Because of its greater variability, both spatially and temporarily, rainfall has a larger effect on moisture deficit than PE. Currently there are just over 100 stations in England and Wales which record enough information to calculate PE using the MORECS programs, but continuous records for the period chosen for ALC (1961-80) do not exist for all of these stations.

3. SURROGATE VERSION OF PSMD

After a certain amount of 'trial and error', using datasets already existing on a 5 km grid, Keers (1985) suggested that a linear regression based on accumulated temperature above 0°C April-September (ATS) and Summer Rainfall April to September (ASR) explained almost 80% of the variability of max PSMD for the 94 stations in the CAD. A large proportion of the remaining 20% is probably due to the effect of windspeed but currently it is not possible to accurately map windspeed on a 5 km grid.

Since the work of Keers (1985), the regressions to produce PSMD have been exhaustively tested. The regressions were then adapted to calculate crop adjusted moisture deficits (MD) for winter wheat and potatoes.

4. CROP ADJUSTED MOISTURE DEFICITS

The adjusted deficits are calculated as:

MD (winter wheat)= MDMWHT = (mid-July PSMD) - 1/3 (April PSMD)

MD (potatoes)= MDMPOT = (August PSMD) - 1/3
(June PSMD) - 1/3 (mid-May PSMD)

For winter wheat the correction is needed as full ground cover is only achieved about the end of April; the crop does not normally require water from the soil after mid-July. Maincrop potatoes are essentially in bare ground until mid-May and full ground cover is generally achieved about the end of June. Growth then continues through the period of maximum deficit, often until the end of August. All these crop-adjusted MD's are smaller than the maximum PSMD so that during a dry June or July where several crops are growing in the same soil type, soil moisture deficits follow the sequence root crops < cereals < grass.

The above models for crop adjusted MD were applied to the MORECS based PSMD data calculated for the 94 CAD stations. Preliminary examination of the above equations showed that it was not necessary to relate ASR and ATS or AAR and ATO to each of the variables on the right hand side, there were better correlations between MDMWHT/POT (the lefthand side of the equations) and ASR/ATS.

Table 3 lists the results of multiple linear regression analysis of factors affecting the resulting MD data. Adding LAT (Nat Grid Northing), LON (Nat Grid Easting) and ALT (Height above sea level) to the regression gave little extra precision to predictions of any of the MD variables, mainly because these three variables account for most of the variation in ATS, the other major parameter used in these regressions.

Table 3 Results of Regression Analysis of Crop Adjusted Moisture Deficit data

Best fit equations

$$MDMWHT = -38.6 - (0.1455 * ASR) + (0.0811 * ATS) \quad r^2 = 79\%$$

$$MDMPOT = -105.4 - (0.1827 * ASR) + (0.1109 * ATS) \quad r^2 = 80\%$$

The analysis indicated that the ASR data have a skewed distribution and so the regressions were repeated using logarithmic and squared transformations of the data.

Table 4 lists the results and shows the improvements in the variation accounted for in MD parameters from using a model incorporating the logarithmic transformation of ASR (potato equation only but similar results were obtained for MDMWHT).

Table 4 Results of Regression Analysis of Crop Adjusted Moisture Deficit data using Logarithmic Transform of ASR

$$MDMPOT = 332.9 - (194.7 * \log_{10} ASR) + (0.1075 * ATS) \quad r^2 = 83\%$$

Within limited ranges of ASR and ATS larger values of r^2 were obtained using such terms as the product of ATS and ASR. But for 'wet' and/or 'cold' ranges of the independent variables, the MD values were meaningless. Given the potential for improving r^2 above the values in Table 4, the option of dropping "misleading" stations in the CAD from the regressions was investigated.

Eleven stations in the complete agromet dataset, with MD data seemingly unrepresentative of their meteorological neighbour with similar ASR and ATS, were excluded and the regression analysis rerun to test the 'goodness of fit'. Table 5 shows an increase in the variation explained by the new regressions, based on the restricted 83 station dataset.

Table 5 Results of Regression Analysis of Crop Adjusted Moisture Deficit using Logarithmic Transform of ASR and based on 83 stations in the CAD

$$MDMWHT = 325.4 - (162.3 * \log_{10} ASR) + (0.08022 * ATS) \quad r^2 = 88\%$$

$$MDMPOT = 326.4 - (196.5 * \log_{10} ASR) + (0.1127 * ATS) \quad r^2 = 88\%$$

References

See reference list to main text.